WHAT IS CLAIMED IS:

1. A method for controlling a compression ignition internal combustion engine exhaust gas recirculation (EGR) system having an EGR valve and actuator, the method comprising:

continuously monitoring at least one engine parameter in real-time; and

continuously adjusting an EGR valve position using a control signal in real-time in response to the at least one parameter and in response to at least one delay, wherein one of the at least one delays corresponds to an EGR actuator delay.

2. The method of claim 1 further comprising determining the control signal via a mathematical model programmed in a controller that comprises a microprocessor and media.

3. The method of claim 1 further comprising determining the control signal in response to a position signal that corresponds to a position or percentage of opening or closing of the EGR valve.

4. The method of claim 1 wherein a desired change for EGR exhaust gas mass flow rate substantially equals a desired EGR exhaust gas mass flow rate minus actual EGR exhaust gas mass flow rate.

5. The method of claim 1 wherein the control signal corresponds to an EGR valve delayed discharge coefficient plus a desired change for the EGR valve discharge coefficient, and the EGR valve delayed discharge coefficient is related to the ratio of the area of the EGR valve outlet at a particular EGR valve opening to the area of the EGR valve inlet area.

6. The method of claim 1 further comprising determining the control signal in response to an intake manifold air pressure.

7. The method of claim 1 further comprising determining the control signal in response to an exhaust manifold exhaust gas pressure.

8. The method of claim 1 further comprising determining the control signal in response to a turbocharger compressor inlet air temperature.

9. The method of claim 1 further comprising determining the control signal in response to a turbocharger compressor inlet air pressure.

10. A system for controlling a compression ignition internal combustion engine exhaust gas recirculation (EGR) system, the system comprising:

an EGR valve having an actuator configured to continuously adjust the EGR valve in real-time in response to a control signal;

at least one sensor for continuously monitoring at least one engine component parameter and presenting in real-time a sensor signal that corresponds to at least one condition of the at least one engine component; and

an engine controller in communication with the EGR actuator and the at least one engine component parameter sensor, the engine controller configured to receive the sensor signal, and present the control signal, wherein the control signal corresponds to at least one delay, and one of the at least one delays is an EGR actuator delay.

11. The system of claim 10 wherein the controller further comprises a microprocessor and media that are programmed with a mathematical model to determine the control signal.

12. The system of claim 10 wherein the at least one engine condition is at least one of an intake manifold air pressure, an exhaust manifold exhaust gas pressure, a turbocharger compressor inlet air temperature, and a turbocharger compressor inlet air pressure.

13. The system of claim 10 wherein a desired change for EGR exhaust gas mass flow rate substantially equals a desired EGR exhaust gas mass flow rate minus actual EGR exhaust gas mass flow rate.

14. The system of claim 10 wherein the control signal corresponds to an EGR valve delayed discharge coefficient plus a desired change for the EGR valve discharge coefficient, and the EGR valve delayed discharge coefficient is related to the ratio of the area of the EGR valve outlet at a particular EGR valve opening to the area of the EGR valve inlet area.

15. The system of claim 10 wherein the control signal is determined in response to a position signal that corresponds to a position or percentage of opening or closing of the EGR valve.

16. A controller for controlling a compression ignition internal combustion engine exhaust gas recirculation (EGR) system, the controller comprising:

at least one output port that presents a control signal to an EGR valve having an actuator configured to adjust the EGR valve in real-time in response to the control signal; and

at least one input port that receives a sensor signal from a respective sensor for continuously monitoring at least one engine component parameter and presenting in real-time the sensor signal that corresponds to at least one condition of the at least one engine component, wherein the controller presents the control signal in response to at least one delay, and one of the at least one delays is an EGR actuator delay.

17. The controller of claim 16 wherein the controller further comprises a microprocessor and media that are programmed with a mathematical model to determine the control signal.

18. The controller of claim 16 wherein the control signal is determined in response to a position signal that corresponds to a position or percentage of opening or closing of the EGR valve.

19. The controller of claim 16 wherein a desired change for EGR exhaust gas mass flow rate substantially equals a desired EGR exhaust gas mass flow rate minus actual EGR exhaust gas mass flow rate.

20. The controller of claim 16 wherein the control signal corresponds to an EGR valve delayed discharge coefficient plus a desired change for the EGR valve discharge coefficient, and the EGR valve delayed discharge coefficient is related to the ratio of the area of the EGR valve outlet at a particular EGR valve opening to the area of the EGR valve inlet area.